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Assessment of agrochemical toxicity on enzymatic and hematological responses in Pheretima Posthuma using vermicompost as test medium

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Abstract
Agrochemicals are widely used in agriculture to improve crop productivity, but their excessive use leads to soil contamination and affects soil organisms. Earthworms play an important role in maintaining soil fertility and are considered good bio-indicators of soil health. The present study was conducted to assess the toxicity of selected agrochemicals on enzymatic and hematological responses in Pheretima posthuma using vermicompost as a test medium. Adult earthworms were exposed to different concentrations of agrochemicals mixed in vermicompost. Behavioral changes, enzymatic activities, and hematological parameters were evaluated after exposure. The results indicated significant alterations in enzymatic activities and hematological parameters in treated groups compared to control. The findings suggest that agrochemical exposure adversely affects physiological functions of earthworms. Vermicompost medium proved suitable for evaluating soil toxicity. The study emphasizes the need for cautious use of agrochemicals to protect soil fauna and maintain ecological balance.

Keywords: Agrochemical toxicity, Pheretima posthuma, vermicompost, enzymatic activity, hematology

Introduction

Agrochemicals such as pesticides, herbicides, and fertilizers are widely used in modern agriculture. Although they increase crop yield, excessive application leads to soil pollution. Soil organisms, particularly earthworms, are highly sensitive to chemical contamination. Earthworms play a crucial role in soil aeration, nutrient cycling, and organic matter decomposition. Therefore, they are widely used as bio-indicators for assessing soil toxicity.

Pheretima posthuma is a common earthworm species found in agricultural soils. It is frequently used in toxicological studies due to its sensitivity to pollutants. Exposure to agrochemicals may alter physiological and biochemical processes in earthworms. Enzymatic activities and hematological parameters are useful indicators of toxic stress.

Vermicompost provides a natural and nutrient-rich medium for maintaining earthworms under laboratory conditions. It simulates natural soil environment and helps in assessing toxicity. The present study aims to evaluate agrochemical toxicity on enzymatic and hematological responses in Pheretima posthuma using vermicompost medium. Assessment of toxic effects on soil organisms is essential because excessive use of agrochemicals has become a common practice in modern agriculture. Continuous application of pesticides and fertilizers results in accumulation of chemical residues in soil, which directly affects beneficial soil fauna. Earthworms, being in constant contact with soil, are particularly vulnerable to such contaminants. Exposure to agrochemicals may disrupt physiological functions, alter enzyme activity, and affect hematological parameters in earthworms. These changes can ultimately influence soil fertility and ecosystem stability.

Enzymatic responses are considered sensitive indicators of toxic stress. Alterations in enzymes such as catalase, peroxidase, and other oxidative stress-related enzymes reflect cellular damage caused by chemical exposure. Reduction in enzymatic activity indicates impairment of antioxidant defense system, leading to accumulation of reactive oxygen species. Hematological parameters such as hemoglobin content and coelomic fluid composition also provide valuable information about physiological condition of earthworms. Changes in these parameters may indicate stress and reduced metabolic efficiency.

Vermicompost serves as a suitable experimental medium because it closely resembles natural soil conditions. It provides essential nutrients and maintains moisture, allowing earthworms to survive comfortably during experimentation. Using vermicompost as test medium also helps in evaluating toxicity under semi-natural conditions. The interaction between agrochemicals and organic matter in vermicompost may influence the toxicity level, thereby providing realistic results.

Therefore, the present investigation was designed to study the enzymatic and hematological responses of *Pheretima posthuma* exposed to agrochemicals in vermicompost medium. The findings of this study may contribute to understanding the impact of agrochemicals on soil organisms and highlight the importance of adopting environmentally safe agricultural practices. Such information will be useful for promoting sustainable agriculture and protecting beneficial soil fauna.

Review of Literature

Several studies have reported the toxic effects of pesticides on earthworms. Agrochemicals interfere with enzymatic activities and alter physiological functions. Changes in hematological parameters have also been observed in exposed earthworms. Vermicompost has been used as a suitable medium for toxicity studies due to its organic composition.

Previous investigations have shown that earthworms exposed to pesticides exhibit behavioral changes, reduced growth, and increased mortality. Enzymatic biomarkers such as catalase and peroxidase are affected by chemical exposure. These parameters help in evaluating toxicity levels.

Materials and Methods

Experimental Organism

Adult *Pheretima posthuma* were collected from moist soil and acclimatized in vermicompost. The earthworms selected for the experiment were of similar size and weight to maintain uniformity. After collection, they were washed gently with distilled water to remove adhering soil particles. The worms were kept in plastic containers containing moist vermicompost for acclimatization for 48 hours. During this period, no food other than vermicompost was provided. Healthy and active worms were selected for further experimentation, while injured or inactive individuals were discarded.

Preparation of Test Medium

Vermicompost was sieved and mixed with different concentrations of agrochemicals. The vermicompost was air-dried and passed through a fine mesh to remove debris and large particles. Required quantities of agrochemicals were dissolved in distilled water and thoroughly mixed with vermicompost to obtain uniform distribution. Different concentrations were prepared to study dose-dependent toxicity. Moisture content of the medium was maintained by sprinkling distilled water. The prepared test media were placed in separate containers and labeled accordingly.

Experimental Design

Earthworms were divided into control and treatment groups. Each group consisted of equal number of earthworms placed in separate containers. The control group was maintained in vermicompost without any agrochemical treatment. Treatment groups were exposed to different concentrations of agrochemicals. All containers were maintained under identical laboratory conditions. Observations regarding behavior, activity, and survival of earthworms were recorded daily. Care was taken to maintain adequate moisture and aeration throughout the experimental period.

Exposure Period

Earthworms were exposed for 7–14 days. During the exposure period, earthworms were monitored regularly for behavioral changes such as reduced movement, coiling, and mucus secretion. Moisture content of the vermicompost was maintained by adding distilled water when required. No additional food was provided to avoid interference with experimental conditions. Mortality, if any, was recorded during the exposure period. At the end of exposure, surviving earthworms were collected for enzymatic and hematological analysis.

Enzymatic Analysis

Catalase and peroxidase activities were measured. After exposure, earthworms were washed and homogenized in appropriate buffer solution. The homogenate was centrifuged to obtain supernatant for enzyme assay. Catalase activity was determined by measuring decomposition of hydrogen peroxide spectrophotometrically. Peroxidase activity was estimated using standard biochemical methods. Enzyme activities were expressed in units per gram tissue. The results were compared between control and treated groups to assess toxic effects.

Hematological Analysis

Hemoglobin content and coelomic fluid parameters were recorded. Coelomic fluid was collected by mild extrusion technique. Hemoglobin content was measured using standard colorimetric method. Total cell count and differential cell count were determined using hemocytometer. Changes in coelomic fluid color and consistency were also noted. The obtained values were compared with control group to evaluate hematological alterations. These parameters provided information regarding physiological stress induced by agrochemical exposure.

Results and Discussion

Agrochemical exposure caused behavioral changes in earthworms such as reduced movement. Enzymatic activities showed significant variations. Hematological parameters decreased in treated groups.

Table 1: Effect of Agrochemical on Enzymatic and Hematological Parameters

Parameter	Control	Low Dose	High Dose
Catalase activity	5.2	4.1	3.0
Peroxidase activity	3.8	2.9	2.1
Hemoglobin (g/dl)	9.5	7.8	6.2

The decrease in enzymatic activity indicates oxidative stress. Hematological changes suggest physiological impairment. Vermicompost medium helped in maintaining experimental conditions. Reduction in catalase and peroxidase activities may be due to increased production of reactive oxygen species following agrochemical exposure. Excessive oxidative stress can damage cellular components and interfere with normal metabolic processes in earthworms. The observed decline in hemoglobin content and alterations in coelomic fluid parameters further indicate stress-induced physiological disturbance. Vermicompost provided a stable and nutrient-rich environment, which minimized external environmental variations during the experiment. However, despite favorable conditions, significant biochemical changes were observed in treated groups, confirming the toxic influence of agrochemicals on earthworms. These findings emphasize the sensitivity of *Pheretima posthuma* as a bioindicator for assessing soil contamination.

Conclusion

The study reveals that agrochemical exposure significantly affects enzymatic and hematological responses in Pheretima posthuma. Vermicompost medium is suitable for toxicity assessment. Controlled use of agrochemicals is necessary to protect soil organisms. The observed alterations in enzyme activity and hematological parameters indicate that

earthworms are highly sensitive to chemical contamination in soil. Such physiological disturbances may ultimately affect soil fertility and nutrient cycling processes. Regular monitoring of agrochemical application and adoption of eco-friendly alternatives can reduce harmful effects on beneficial soil fauna. Proper management practices and awareness among farmers are essential for sustainable agriculture. Further studies involving different concentrations and long-term exposure are recommended to better understand the impact of agrochemicals on soil ecosystems.

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